CLAIMS:

1. A resistance temperature detector suitable for detecting temperatures between windings of an electrical machine, each winding including a conductor at least partially surrounded by a winding insulating system having a predetermined capacitance per unit area, the detector comprising:

a resistive element configured to receive an input signal and to produce an output signal that is a function of temperature;

a detector insulating system disposed about and completely encasing the resistive element, the detector insulating system having a capacitance per unit area approximately equal to or greater than the capacitance per unit area of the winding insulating system.

2. The resistance temperature detector of claim 1, wherein individual materials comprising the winding insulating system and the detector insulating system have dielectric constants between approximately 3 and 6.

3. The resistance temperature detector of claim 1, wherein the detector insulating system includes a plurality of layers of a flexible insulating material and a plurality of layers of an adhesive disposed between the layers of flexible insulating material.

4. The resistance temperature detector of claim 3, wherein the flexible insulating material comprises polyimide, polyester, polyamide-imide, polyetheretherketone, polysulfone or polyphenylene sulfide.

5. The resistance temperature detector of claim 3, wherein the adhesive is selected from the group consisting of acrylic, epoxy, silicone, polyester, and polyurethane adhesive systems.

6. A resistance temperature detector suitable for detecting temperatures between windings of an electrical machine, the detector comprising:

a resistive element configured to receive a measurement signal and to produce an output signal that is a function of temperature;

a detector insulating system disposed about and completely encasing the resistive element, the detector insulating system having a capacitance per unit area of sufficient magnitude that a voltage stress level experienced by any air voids or low dielectric materials adjacent to the resistive element resulting from voltage applied to the windings during operation is below a stress level that would cause partial discharge in such voids and materials.

7. The resistance temperature detector of claim 6, wherein partial discharge in the air voids occurs at a breakdown voltage predicted by Paschen's Law.

8. The resistance temperature detector of claim 6, wherein the voltage stress level that would cause partial discharge is a function of temperature of the air voids or low dielectric materials.

9. The resistance temperature detector of claim 6, wherein individual materials comprising a winding insulating system and the detector insulating system have dielectric constants between approximately 3 and 6.

10. The resistance temperature detector of claim 6, wherein the detector insulating system includes a plurality of layers of a flexible insulating material and a plurality of layers of an adhesive disposed between the layers of flexible insulating material.

11. The resistance temperature detector of claim 10, wherein the flexible insulating material comprises a polyimide, polyester, polyamide-imide, polyetheretherketone, polysulfone or polyphenylene sulfide.

12. The resistance temperature detector of claim 10, wherein the adhesive is selected from the group consisting of acrylic, epoxy, silicone, polyester, and polyurethane adhesive systems.

13. A resistance temperature detector system for detecting temperatures between windings of an electrical machine, the system comprising:

a winding configured to receive an alternating current voltage waveform during operation, the winding having a winding insulating system disposed about a central conductor; and

a resistive temperature detector disposed adjacent to the winding for detecting a temperature of the winding during operation, the detector comprising a resistive element configured to receive a measurement signal and to produce an output signal that is a function of temperature, and a detector insulating system disposed about and completely encasing the resistive element;

wherein the combination of the winding insulating system and the detector insulating system have a capacitance sufficient that a voltage stress level experienced by any air voids or low dielectric materials adjacent to the resistive element resulting from voltage applied to the winding during operation is below a stress level that would cause partial discharge in such voids and materials.

14. A resistance temperature detector system for detecting temperatures between windings of an electrical machine, the system comprising:

a stator having a plurality of winding slots;

a plurality of windings disposed in the winding slots and configured to receive alternating current voltage waveforms during operation, each winding having a winding insulating system disposed about a central conductor; and

a resistive temperature detector disposed between adjacent windings in at least one of the slots for detecting a temperature of the adjacent windings during operation, the detector comprising a resistive element configured to receive a measurement signal and to produce an output signal that is a function of temperature, and a detector insulating system disposed about and completely encasing the resistive element;

wherein the combination of the winding insulating system and the detector insulating system have a capacitance sufficient that a voltage stress level experienced by any air voids or low dielectric materials adjacent to the resistive element resulting from

voltage applied to the winding during operation is below a stress level that would cause partial discharge in such voids and materials.

15. A method for detecting temperatures between windings of an electrical machine, the method comprising:

providing a resistive element configured to receive a measurement signal and to produce an output signal that is a function of temperature;

disposing the resistive element within a detector insulating system to form a detector, the detector insulating system having a desired capacitance per unit area of sufficient magnitude that a voltage stress level experienced by any air voids or low dielectric materials adjacent to the resistive element resulting from voltage applied to the windings during operation is below a stress level that would cause partial discharge in such voids and materials.

16. The method of claim 15, further comprising coupling the resistive element to connection plates for supply of the measurement signal and for detection of the output signal.

17. The method of claim 16, further comprising coupling the connection plates to a set of lead wires including a compensation lead wire.

18. The method of claim 15, wherein disposing the resistive element within the detector insulating system includes joining a plurality of flexible insulative layers about the resistive element.

19. The method of claim 18, wherein the flexible insulative layers comprise a polyimide, polyester, polyamide-imide, polyetheretherketone, polysulfone or polyphenylene sulfide.

20. The method of claim 18, wherein the flexible insulative layers are joined by an adhesive.

21. The method of claim 20, wherein the flexible insulative layers and the adhesive have dielectric constants between approximately 3 and 6.

22. The method of claim 15, further comprising disposing the detector between adjacent windings of an electrical machine stator.